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ABSTRACT: *The use of loess soils in seismic zones, especially in areas with a high risk of earthquakes, is quite complex and requires caution. Advanced methods for utilizing loess soils in seismic zones are based on specific technologies and approaches. These methods are crucial for effective and safe earthquake-resistant construction. Loess soils can be vulnerable to seismic impacts; therefore, it is important to properly manage and prepare them. A number of advanced technologies and methods are employed to ensure the safety of construction in such areas. Below are advanced methods for using loess soils in seismic zones. We will examine ways to mitigate these risks.*

KEYWORDS: *Seismic zones, loess soil, cement stabilization, geosynthetic materials, geotextiles, dynamic compaction, drainage, seismic barriers, monitoring, systems, anti-erosion protection, landfill construction, organic matter, water permeability, polyethylene, polypropylene, stabilization.*

INTRODUCTION

Decree of the President of the Republic of Uzbekistan dated May 30, 2022 No. UP-144 "On Measures for Further Improvement of the Seismic Safety System of the Republic of Uzbekistan" In recent years, large-scale comprehensive measures have been implemented in our country to develop the field of seismology, ensuring the seismic resistance of structures and seismic safety, as well as to radically increase the efficiency of organizations in this area. Today, the consistent continuation of reforms in these areas and the introduction of new methods for ensuring the seismic safety of the population are of great importance.

The use of loess soils in construction can have some inconveniences, since they have certain physical and mechanical properties. At the same time, their use in construction can be carried out with the implementation of certain measures.

When loess soils are used in construction, it is necessary to spend more time, resources, and labor to create a strong and stable foundation for them. Well-prepared and stabilized loess soils can also be successfully used in foundations and other structures.

MAIN PART

In seismic zones, loess soils, due to their special properties, are very important for use in construction and require caution.

Loess soils mainly have the following properties:

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1. Low softness and strength: Loess soils are naturally soft and easily modifiable. Such soils can have high water absorption capacity, therefore they cause difficulties in ensuring stability in construction.
2. Water absorption: Loess soils absorb water well, but this means that they can change their state in a short time, i.e., be washed away and hardened. In rural areas, they can cause more erosion and soil displacement.
3. If improperly processed: Loess soils should be well prepared to create a solid foundation for construction. For example, soil compaction, mixing, and stabilization may be necessary. Otherwise, loess soils can pose a threat to the building structure.
4. Methods for improving loess soils: The following methods are often used to improve the quality of loess soils:
   - Compaction of loess soils: This method increases the strength of loess soils.
   - Water drainage: If loess soils are very moist, drainage systems must be installed for water drainage.
   - Use of chemicals: Some chemicals, such as cement or gypsum, may be used to stabilize loess soils.[1-10]

Loess soils can also cause a number of problems in areas that are in the seismic hazard zone, as they can be sensitive to earthquakes. Below are some important points about loess soils in seismic regions:

1. Water absorption and compression: - Loess soils absorb water well, and their structure changes easily. During earthquakes, these soils can briefly swell or compress, undergoing various physical changes. If the moisture content in loess soils is high, during seismic impact, loess soils can lead to strong displacements, thereby creating a danger for foundations and building structures.

2. Liquefaction of loess soils - in seismic phenomena, especially in desert areas, due to the fact that loess soils have good water absorption properties, there is a risk of "liquefaction of loess soils." This phenomenon leads to a sharp decrease in the strength of loess soils during earthquakes, causing them to move like a liquid. As a result, foundations and other structures can be seriously damaged. This dangerous situation is especially common in loess soils not prepared for construction (1-image).

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1-image. Smoothing of loess soils

3. Stability of loess soils: - Due to seismic effects, loess soils can lose and change their natural stability. Loess soils, as a rule, can cause problems with maintaining stability. This, in turn, can lead to displacement or deformation of the building foundations.

4. Stabilization of loess soils: - When working with loess soils in seismic zones, it is necessary to take a number of measures to strengthen and stabilize the soil. Including:

• Compaction of loess soils: compaction work should be carried out to prevent compression and dilution of loess soils.

• Installation of drainage systems: Drainage systems are important for rapid water removal and drainage of loess soils.

• Chemical strengthening of loess soils: Cement, gypsum, or other chemicals can be used to increase the stability of loess soils.[11-16]

Selection of building materials and structures

When carrying out construction on loess soils in a seismic zone, it is necessary to choose special building materials and equipment. For foundations, it is necessary to use strong, elastic, and vibration-resistant materials. In addition, taking into account the high seismic risk, the design of building structures and engineering approaches can also be changed.

Advanced methods for the use of loess soils in seismic zones are based on the following technologies and approaches. These methods are important for effective and safe earthquake-resistant construction. Loess soils can be vulnerable to seismic impacts, therefore it is important to properly manage and prepare them.

Foundation design and seismic barriers

Special design approaches are used to reduce seismic risk when constructing foundations on loess soils.

• Flexible foundations: Special designs are developed to increase the elasticity of the foundation. These foundations adapt to the structure during vibrations and are resistant to strong tremors.

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• Seismic barriers (dampers): Dampers or other seismic barriers are installed to increase the elasticity of the foundation against seismic impacts. This method helps to maintain the intended stability of the building during shaking.

Replacement of loess soil

If loess soils are very soft and vulnerable to seismic impact, they can be replaced with stronger and more resistant to tremors soils.

• Replacement with high-quality materials: The strength of the foundation can be increased by replacing the soil layer with sand, gravel, or other stable materials instead of loess soils.

• Constructing and strengthening loess soils: Special techniques are used to mix loess soils and achieve the desired mechanical properties.

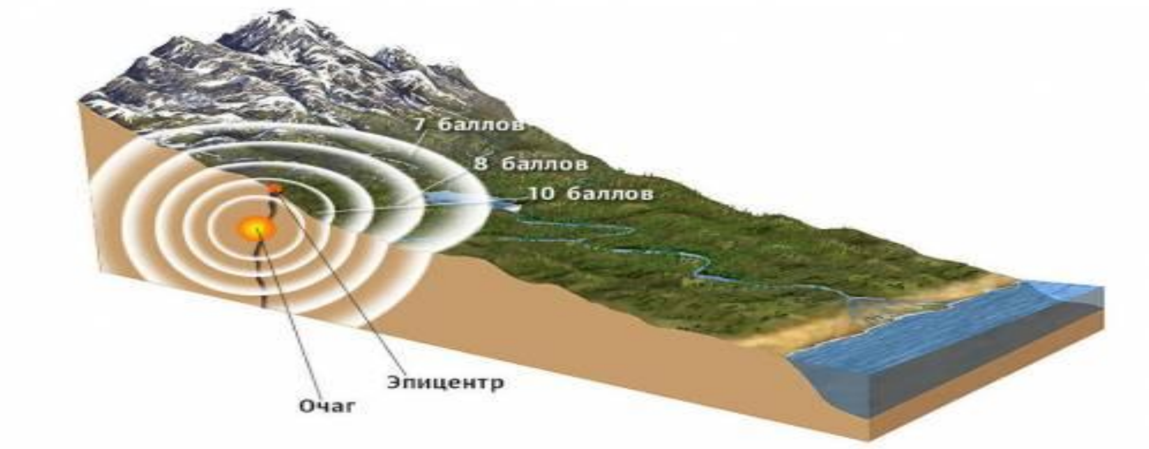
Seismic monitoring and analysis

Presidential Decree No. PP-4794 dated 30.07.2020 "On Measures for the Fundamental Improvement of the System for Ensuring Seismic Safety of the Population and Territory of the Republic of Uzbekistan" has been adopted. The document approved the Program for Improving the Seismic Safety System in the Republic of Uzbekistan.

It is necessary to correctly assess and analyze seismic hazard in advance. This makes it possible to be prepared for seismic events and manage them with minimal damage (2-image).

• Seismic monitoring systems: Modern sensors and systems can be installed in buildings and structures to monitor seismic phenomena. These systems help measure the strength and impact of tremors.

• Assessment of the seismic properties of loess soils: For new construction, it is important to conduct a preliminary analysis of the seismic properties of loess soils. Based on this analysis, construction design and safety measures can be determined.



2-image. Seismic monitoring and analysis

Geotechnical approaches

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Geotechnical research and, based on it, special approaches to construction are developed. These approaches help minimize seismic hazards and make the construction process safer.

• Geosynthetic materials: Geotextile or gecomposite materials are used to strengthen layers of loess soils and stabilize foundation bases. These are synthetic materials used when working with building materials such as loess soils, concrete, and asphalt. They are intended for various engineering, construction, and infrastructure works, which contribute to strengthening, stabilizing, and ensuring the safety of loess soils. Geosynthetic materials are widely used mainly in the geotechnical field and perform important functions, such as strengthening loess soils, preventing erosion, improving drainage, and strengthening foundations. [17-21]

Types of geosynthetic materials

Geotextile: - is a woven or non-woven fabric, usually made from synthetic fibers such as polypropylene or polyester.

• Function: Geotextile materials are used for filtration, anti-erosion protection, and strengthening of loess soils. They are also used to prevent the separation of loess soil layers and improve drainage.

• Application: widely used in road construction, anti-erosion protection of barriers, rivers and roads, land cultivation and foundation strengthening.

• Geosynthetic membranes: These are thin, impermeable materials. They are usually made from materials such as polyethylene, polypropylene, or PVC.

• Function: these materials are impermeable to water or other liquids, therefore they are used for water separation, for collecting mixed or contaminated water, and for insulating liquids from the ground.

• Application: used in agriculture, landfill construction, river and water barriers, rainwater accumulations, and reservoirs.

• Geogrids: a network-like material made of plastic or other synthetic materials. Geogrids are used in the construction of a number of roads and soil stabilization.

• Function: Geogrids are used for strengthening loess soils and lifting heavy loads. They help to retain loess soils and prevent erosion.

• Application: used in road and railway construction, barrier construction, earthworks, etc.

• Geocomposite: this is a combination of one or more geosynthetic materials. For example, the combination of geotextile and geogrids.

• Function: Geocomposites are often used for drainage, filtration, and reinforcement purposes. They combine the functions of two or more materials.

• Application: used in large construction projects, including road construction, river stabilization, water barriers, and landfill systems.

Advantages of geosynthetic materials

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• Strengthening loess soils: Geosynthetic materials help strengthen loess soils and prevent their displacement. This ensures stability of foundations, roads, and other infrastructure.

• Erosion protection: Geosynthetic materials protect loess soils from erosion and reduce the impact of water flow. This is especially important for barriers and road construction.

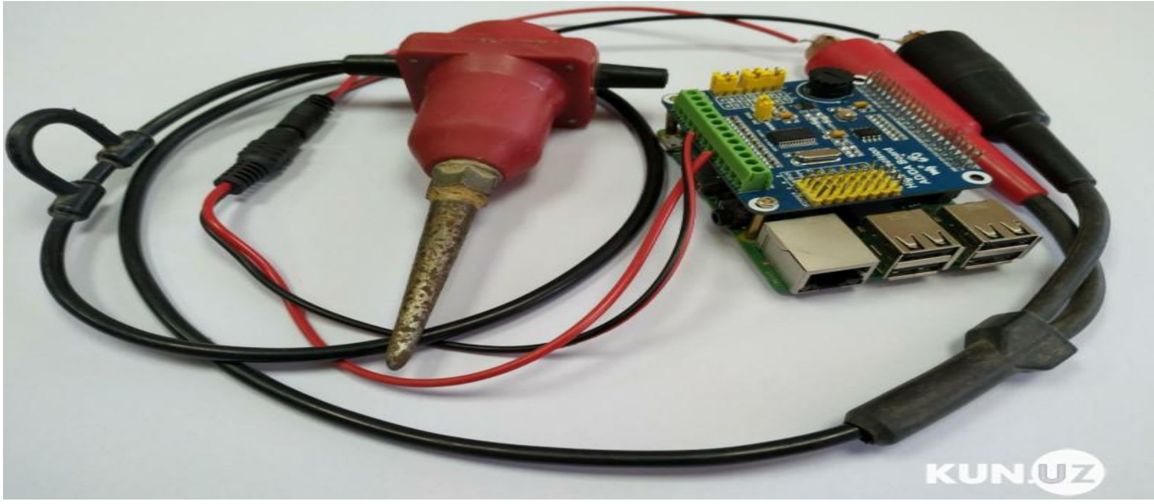
• Improving drainage: Geosynthetic materials work effectively in draining loess soils, accumulating water, and separating contaminated waters.

• Environmental safety: They are designed for long-term use and are environmentally safe, as their long-term impact does not negatively affect loess soils.

• Economy and easy installation: Geosynthetic materials require less time and labor to install compared to traditional building materials, and they can be much cheaper [22-24].

Conclusions and recommendations. In seismic zones, loess soils, naturally, due to their unfavorable properties, require additional precautions for construction. In such areas, before carrying out construction work, it is necessary to carefully analyze the loess soil and take special engineering measures. Otherwise, significant damage and risks may arise due to seismic impacts.

The first device for determining seismic zones has been developed in Uzbekistan. For the first time in local conditions, a group of employees of the Center for Advanced Innovations under the Ministry of Innovative Development has developed a device that accurately shows the strength of an earthquake. Until now, instruments for measuring the strength of earthquakes in the fields of geology and construction were imported from abroad, and their cost was correspondingly high (3-image).



3-image. The first device for determining seismic zones in Uzbekistan

In seismic zones, using the above-mentioned advanced methods for construction on loess soils, it is possible to stabilize, stabilize, and protect the soil from seismic hazards. Such methods are necessary to ensure the safety of construction and reduce potential risks.

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Each project is unique, and it is necessary to apply such methods with the help of experienced engineers.

Geosynthetic materials are of great importance as effective and multifunctional materials in the fields of construction and engineering. They are very useful in stabilizing soil, preventing erosion, improving drainage, and strengthening construction systems. With the help of geosynthetic materials, construction processes are carried out faster and safer.

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